

SEQUENCE LISTING

1) GENERAL INFORMATION:

- (i) APPLICANT: Life Technologies, Inc.  
8717 Grovemont Circle  
Gaithersburg, MD 20884-9980  
APPLICANTS/INVENTORS: Chatterjee, Deb K.
- (ii) TITLE OF INVENTION: Cloned DNA Polymerases from *Thermotoga* and Mutants Thereof
- (iii) NUMBER OF SEQUENCES: 22

- (iv) CORRESPONDENCE ADDRESS:
- (A) ADDRESSEE: STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.  
(B) STREET: 1100 New York Ave., N.W., Suite 600  
(C) CITY: Washington  
(D) STATE: DC  
(E) COUNTRY: USA  
(F) ZIP: 20005
- (v) COMPUTER READABLE FORM:
- (A) MEDIUM TYPE: Floppy disk  
(B) COMPUTER: IBM PC compatible  
(C) OPERATING SYSTEM: PC-DOS/MS-DOS  
(D) SOFTWARE: PatentIn Release #1.0, Version #1.30

- (vi) CURRENT APPLICATION DATA:
- (A) APPLICATION NUMBER: To be assigned  
(B) FILING DATE: Herewith  
(C) CLASSIFICATION:

- (vii) PRIOR APPLICATION DATA:
- (A) APPLICATION NUMBER: 08/525,057  
(B) FILING DATE: 08-SEP-1995  
(C) CLASSIFICATION:

- (vii) PRIOR APPLICATION DATA:
- (A) APPLICATION NUMBER: 08/537,397  
(B) FILING DATE: 02-OCT-1995  
(C) CLASSIFICATION:

- (vii) PRIOR APPLICATION DATA:
- (A) APPLICATION NUMBER: 08/537,400  
(B) FILING DATE: 02-OCT-1995  
(C) CLASSIFICATION:

(vii) PRIOR APPLICATION DATA:  
(A) APPLICATION NUMBER: 08/576,759  
(B) FILING DATE: 21-DEC-1995  
(C) CLASSIFICATION:

(vii) PRIOR APPLICATION DATA:  
(A) APPLICATION NUMBER: To be assigned  
(B) FILING DATE: 14-AUG-1996  
(C) CLASSIFICATION:

(viii) ATTORNEY/AGENT INFORMATION:  
(A) NAME: Esmond, Robert W.  
(B) REGISTRATION NUMBER: 32,893  
(C) REFERENCE/DOCKET NUMBER: 0942.280PC03

(ix) TELECOMMUNICATION INFORMATION:  
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(2) INFORMATION FOR SEQ ID NO:1:

(i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 23 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: both  
(D) TOPOLOGY: both

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

GAGCTCACGG GGGATGCAGG AAA

23

(2) INFORMATION FOR SEQ ID NO:2:

(i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 2682 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: both  
(D) TOPOLOGY: both

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

ATGGCGAGAC TATTCTCTT TGATGGCACA GCCCTGGCCT ACAGGGCATA TTACGCCCTC 60  
GACAGATCCC TTTCCACATC CACAGGAATT CCAACGAACG CCGTCTATGG CGTTGCCAGG 120  
ATGCTCGTTA AATTCAATTAA GGAACACATT ATACCCGAAA AGGACTACGG GGCTGTGGCC 180  
TTCGACAAGA AGGCAGCGAC GTTCAGACAC AAACTGCTCG TAAGCGACAA GGCGCAAAGG 240  
CCAAAGACTC CGGCTCTTCT AGTTCAAGCAG CTACCTTACA TCAAGCGGCT GATAGAAGCT 300  
CTTGGTTTCA AAGTGCTGGA GCTGGAGGGAG TACGAAGCAG ACGATATCAT CGCCACGCTT 360  
GCAGTCAGGG CTGCACGTTT TTTGATGAGA TTTTCATTAA TAACCGGTGA CAAGGATATG 420  
CTTCAACTTG TAAACGAGAA GATAAAGGTC TGGAGAATCG TCAAGGGGAT ATCGGATCTT 480  
GAGCTTTACG ATTGAAAAAA GGTGAAAGAA AGATACGGTG TGGAAACCACA TCAGATAACCG 540  
GATCTTCTAG CACTGACGGG AGACGACATA GACAACATTC CCGGTGTAAC GGGAAATAGGT 600  
GAAAAGACCG CTGTACAGCT TCTCGGCAAG TATAGAAATC TTGAATACAT TCTGGAGCAT 660  
GCCCGTGAAC TCCCCCAGAG AGTGAGAAAG GCTCTTTGA GAGACAGGGAG AGTTGCCATC 720  
CTCAGTAAAA AACTTGCAAC TCTGGTGACG AACSCACCTG TTGAAGTGGA CTGGGAAGAG 780  
ATGAAATACA GAGGATACGA CAAGAGAAAA CTACTTCCGA TATTGAAAGA ACTGGAGTTT 840  
GCTTCCATCA TGAAGGAAC TCAACTGTAC GAAGAACGAG AACCCACCGG ATACGAAATC 900  
GTGAAGGATC ATAAGACCTT CGAAGATCTG ATCGAAAAGC TGAAGGAGGT TCCATCTTT 960  
GCCCTGGACC TTGAAACGTC CTCCTGGAC CCGTTCAACT GTGAGATAGT CGGCATCTCC 1020  
GTGTCGTTCA AACCGAAAAC AGCTTATTAC ATTCCACTTC ATCACAGAAA CGCCCACAAT 1080  
CTTGATGAAA CACTGGTGCT GTCGAAGTTG AAAGAGATCC TCGAAGACCC GTCTCGAAG 1140  
ATTGTGGGTC AGAACCTGAA GTACGACTAC AAGGTTCTTA TGGTAAAGGG TATATCGCCA 1200  
GTTTATCCGC ATTTGACAC GATGATAGCT GCATATTTGC TGGAGCCAAA CGAGAAAAAA 1260  
TTCAATCTCG AAGATCTGTC TTTGAAATTCTCGGATACA AAATGACGTC TTATCAGGAA 1320  
CTGATGTCGT TTTCTCACC ACTTTTGTT TTCAGCTTG CGGATGTTCC GGTAGACAAG 1380  
GCTGCCGAAT ACTCCTCGA GGATGCAGAC ATCACTTATA GGCTCTACAA GATACTCAGC 1440  
ATGAAGCTCC ATGAAGCGGA ACTTGAGAAC GTCTTCTACA GGATAGAGAT GCCGTTGGTG 1500  
AACGTCTTGG CACGAATGGA ATTCAACTGG GTGTATGTTG ACACAGAATT CCTGAAAAAG 1560  
CTCTCGGAGG AGTACGGCAA AAAGCTCGAG GAACTGGCCG AAAAAATCTA CCAGATAGCA 1620

GGTGAGCCCT TCAACATCAA TTCTCCAAAA CAGGTTCAA ACATCCTTT TGAGAAGCTG	1680
GGAATAAAAC CCCGTGGAAA AACGACAAAA ACAGGAGATT ACTCTACCAG GATAGAGGTG	1740
TTGGAAGAGA TAGCGAATGA GCACGAGATA GTACCCCTCA TTCTCGAGTT CAGAAAGATC	1800
CTGAAACTGA AATCGACCTA CATAGACACC CTTCCGAAAC TTGTGAACCC GAAAACCGGA	1860
AGATTTCATG CATCTTCCA CCAGACGGGT ACCGCCACTG GCAGGTTGAG TAGCAGTGAT	1920
CCAAATCTTC AGAACATCTCC GACAAAGAGC GAAGAGGGAA AAGAAATTAG AAAAGCGATT	1980
GTGCCCGAGG ATCCAGACTG GTGGATCGTC AGTGCGGATT ATTCCCAAAT AGAAACTCAGA	2040
ATCCTCGCTC ATCTCAGTGG TGATGAGAAC CTTGTGAAGG CCTTCGAGGA GGGCATCGAT	2100
GTGCACACCT TGACTGCCTC CAGGATCTAC AACGTAAGC CAGAAGAAGT GAACGAAGAA	2160
ATGCGACGGG TTGGAAAGAT GGTGAACCTTC TCTATAATAT ACGGTGTAC ACCGTACGGT	2220
CTTTCTGTGA GACTTCCAAT ACCGGTTAAA GAAGCAGAAA AGATGATTAT CAGCTATTTC	2280
ACACTGTATC CAAAGGTGCG AAGCTACATC CAGCAGGTTG TTGCAGAGGC AAAAGAGAAG	2340
GGCTACGTCA GGACTCTCTT TGGAAGAAAA AGAGATATTC CCCAGCTCAT GGCAAGGGAC	2400
AAGAACACCC AGTCCGAAGG CGAAAGAATC GCGATAAAACA CCCCCATTCA GGGAACTGCG	2460
GCAGATATAA TAAAATTGGC TATGATAGAT ATAGACGAGG AGCTGAGAAA AAGAAACATG	2520
AAATCCAGAA TGATCATTCA GGTCATGAC GAACTGGTCT TCGAGGTTCC CGATGAGGAA	2580
AAAGAAGAAC TAGTTGATCT GGTGAAGAAC AAAATGACAA ATGTGGTGAA ACTCTCTGTG	2640
CCTCTTGAGG TTGACATAAG CATCGAAAAA AGCTGGTCTT GA	2682

(2) INFORMATION FOR SEQ ID NO:3:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 893 amino acids
  - (B) TYPE: amino acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

Met Ala Arg Leu Phe Leu Phe Asp Gly Thr Ala Leu Ala Tyr Arg Ala  
1 5 10 15

Tyr Tyr Ala Leu Asp Arg Ser Leu Ser Thr Ser Thr Gly Ile Pro Thr  
20 25 30

Asn Ala Val Tyr Gly Val Ala Arg Met Leu Val Lys Phe Ile Lys Glu  
35 40 45

His Ile Ile Pro Glu Lys Asp Tyr Ala Ala Val Ala Phe Asp Lys Lys  
50 55 60

Ala Ala Thr Phe Arg His Lys Leu Leu Val Ser Asp Lys Ala Gln Arg  
65 70 75 80

Pro Lys Thr Pro Ala Leu Leu Val Gln Gln Leu Pro Tyr Ile Lys Arg  
85 90 95

Leu Ile Glu Ala Leu Gly Phe Lys Val Leu Glu Leu Glu Gly Tyr Glu  
100 105 110

Ala Asp Asp Ile Ile Ala Thr Leu Ala Val Arg Ala Ala Arg Phe Leu  
115 120 125

Met Arg Phe Ser Leu Ile Thr Gly Asp Lys Asp Met Leu Gln Leu Val  
130 135 140

Asn Glu Lys Ile Lys Val Trp Arg Ile Val Lys Gly Ile Ser Asp Leu  
145 150 155 160

Glu Leu Tyr Asp Ser Lys Lys Val Lys Glu Arg Tyr Gly Val Glu Pro  
165 170 175

His Gln Ile Pro Asp Leu Leu Ala Leu Thr Gly Asp Asp Ile Asp Asn  
180 185 190

Ile Pro Gly Val Thr Gly Ile Gly Glu Lys Thr Ala Val Gln Leu Leu  
195 200 205

Gly Lys Tyr Arg Asn Leu Glu Tyr Ile Leu Glu His Ala Arg Glu Leu  
210 215 220

Pro Gln Arg Val Arg Lys Ala Leu Leu Arg Asp Arg Glu Val Ala Ile  
225 230 235 240

Leu Ser Lys Lys Leu Ala Thr Leu Val Thr Asn Ala Pro Val Glu Val  
245 250 255

Asp Trp Glu Glu Met Lys Tyr Arg Gly Tyr Asp Lys Arg Lys Leu Leu  
260 265 270

Pro Ile Leu Lys Glu Leu Glu Phe Ala Ser Ile Met Lys Glu Leu Gln  
275 280 285

Leu Tyr Glu Glu Ala Glu Pro Thr Gly Tyr Glu Ile Val Lys Asp His  
290 295 300

Lys Thr Phe Glu Asp Leu Ile Glu Lys Leu Lys Gly Val Pro Ser Phe  
305 310 315 320

Ala Leu Asp Leu Glu Thr Ser Ser Leu Asp Pro Phe Asn Cys Glu Ile  
325 330 335

Val Gly Ile Ser Val Ser Phe Lys Pro Lys Thr Ala Tyr Tyr Ile Pro  
340 345 350

Leu His His Arg Asn Ala His Asn Leu Asp Glu Thr Leu Val Leu Ser  
355 360 365

Lys Leu Lys Glu Ile Leu Glu Asp Pro Ser Ser Lys Ile Val Gly Gln  
370 375 380

Asn Leu Lys Tyr Asp Tyr Lys Val Leu Met Val Lys Gly Ile Ser Pro  
385 390 395 400

Val Tyr Pro His Phe Asp Thr Met Ile Ala Ala Tyr Leu Leu Glu Pro  
405 410 415

Asn Glu Lys Lys Phe Asn Leu Glu Asp Leu Ser Leu Lys Phe Leu Gly  
420 425 430

Tyr Lys Met Thr Ser Tyr Gln Glu Leu Met Ser Phe Ser Ser Pro Leu  
435 440 445

Phe Gly Phe Ser Phe Ala Asp Val Pro Val Asp Lys Ala Ala Glu Tyr  
450 455 460

Ser Cys Glu Asp Ala Asp Ile Thr Tyr Arg Leu Tyr Lys Ile Leu Ser  
465 470 475 480

Met Lys Leu His Glu Ala Glu Leu Glu Asn Val Phe Tyr Arg Ile Glu  
485 490 495

Met Pro Leu Val Asn Val Leu Ala Arg Met Glu Phe Asn Trp Val Tyr  
500 505 510

Val Asp Thr Glu Phe Leu Lys Lys Leu Ser Glu Glu Tyr Gly Lys Lys  
515 520 525

Leu Glu Glu Leu Ala Glu Lys Ile Tyr Gln Ile Ala Gly Glu Pro Phe  
530 535 540

Asn Ile Asn Ser Pro Lys Gln Val Ser Asn Ile Leu Phe Glu Lys Leu  
545 550 555 560

Gly Ile Lys Pro Arg Gly Lys Thr Thr Lys Thr Gly Asp Tyr Ser Thr  
565 570 575

Arg Ile Glu Val Leu Glu Glu Ile Ala Asn Glu His Glu Ile Val Pro  
580 585 590

Leu Ile Leu Glu Phe Arg Lys Ile Leu Lys Leu Lys Ser Thr Tyr Ile  
595 600 605

Asp Thr Leu Pro Lys Leu Val Asn Pro Lys Thr Gly Arg Phe His Ala  
610 615 620

Ser Phe His Gln Thr Gly Thr Ala Thr Gly Arg Leu Ser Ser Ser Asp  
625 630 635 640

Pro Asn Leu Gln Asn Leu Pro Thr Lys Ser Glu Glu Gly Lys Glu Ile  
645 650 655

Arg Lys Ala Ile Val Pro Gln Asp Pro Asp Trp Trp Ile Val Ser Ala  
660 665 670

Asp Tyr Ser Gln Ile Glu Leu Arg Ile Leu Ala His Leu Ser Gly Asp  
675 680 685

Glu Asn Leu Val Lys Ala Phe Glu Glu Gly Ile Asp Val His Thr Leu  
690 695 700

Thr Ala Ser Arg Ile Tyr Asn Val Lys Pro Glu Glu Val Asn Glu Glu  
705 710 715 720

Met Arg Arg Val Gly Lys Met Val Asn Phe Ser Ile Ile Tyr Gly Val  
725 730 735

Thr Pro Tyr Gly Leu Ser Val Arg Leu Gly Ile Pro Val Lys Glu Ala  
740 745 750

Glu Lys Met Ile Ile Ser Tyr Phe Thr Leu Tyr Pro Lys Val Arg Ser  
755 760 765

Tyr Ile Gln Gln Val Val Ala Glu Ala Lys Glu Lys Gly Tyr Val Arg  
770 775 780

Thr Leu Phe Gly Arg Lys Arg Asp Ile Pro Gln Leu Met Ala Arg Asp  
785 790 795 800

Lys Asn Thr Gln Ser Glu Gly Glu Arg Ile Ala Ile Asn Thr Pro Ile  
805 810 815

Gln Gly Thr Ala Ala Asp Ile Ile Lys Leu Ala Met Ile Asp Ile Asp  
820 825 830

Glu Glu Leu Arg Lys Arg Asn Met Lys Ser Arg Met Ile Ile Gln Val  
835 840 845

His Asp Glu Leu Val Phe Glu Val Pro Asp Glu Glu Lys Glu Leu  
850 855 860

Val Asp Leu Val Lys Asn Lys Met Thr Asn Val Val Lys Leu Ser Val  
865 870 875 880

Pro Leu Glu Val Asp Ile Ser Ile Gly Lys Ser Trp Ser  
885 890

(2) INFORMATION FOR SEQ ID NO:4:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 11 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:4:

Pro Ser Phe Ala Leu Asp Leu Glu Thr Ser Ser  
1 5 10

(2) INFORMATION FOR SEQ ID NO:5.

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 11 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:5:

Pro Val Phe Ala Phe / Asp Thr Glu Thr Asp Ser  
 1 . . . . . 5 / 10

(2) INFORMATION FOR SEQ ID NO:6.

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 11 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 6.

Gly Pro Val Ala Phe Asp Ser Glu Thr Ser Ala  
1                   5                   10

(2) INFORMATION FOR SEQ ID NO:7:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 10 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear
- (ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:7:

Met Ile Val Ser Asp Ile Glu Ala Asn Ala  
1               5                   10

(2) INFORMATION FOR SEQ ID NO:8:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 26 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:8:

GACGTTTCAA GCGCTAGGGC AAAAGA

26

(2) INFORMATION FOR SEQ ID NO:9:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 10 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:9:

Lys Met Val Asn Phe Ser Ile Ile Tyr Gly

1

5

10

(2) INFORMATION FOR SEQ ID NO:10:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 10 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:10:

Lys Ala Ile Asn Phe Gly Leu Ile Tyr Gly  
1 5 10

(2) INFORMATION FOR SEQ ID NO:11:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 10 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:11:

Lys Ala Ile Thr Phe Gly Ile Leu Tyr Gly  
1 5 10

(2) INFORMATION FOR SEQ ID NO:12:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 10 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:12:

Lys Thr Phe Ile Tyr Gly Phe Leu Tyr Gly

1

5

10

(2) INFORMATION FOR SEQ ID NO:13:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 10 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: peptide

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:13:

Lys Thr Ile Asn Phe Gly Val Leu Tyr Gly  
1 5 10

(2) INFORMATION FOR SEQ ID NO:14:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:14:

GTATATTATA GAGTAGTTAA CCATCTTCC A

31

(2) INFORMATION FOR SEQ ID NO:15:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 36 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:15:

GTAGGCCAGG GGCTGTGCCG GCAAAGAGAA ATAGTC

36

(2) INFORMATION FOR SEQ ID NO:16:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 35 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:16:

GAAGGATATC CTTGGCGCCG GTTATTATGA AAATC

35

(2) INFORMATION FOR SEQ ID NO:17:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 1310 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: both  
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:17:

ATGGCGAGAC TATTTCTCTT TGATGGCAC A GCCCTGGCCT ACAGGGCATA TTACGCCCTC	60
GACAGATCCC TTTCCACATC CACAGGAATT CCAACGAACG CCGTCTATGG CGTTGCCAGG	120
ATGCTCGTTA AATTCAATTAA GGAACACATT ATACCCGAAA AGGACTACGC GGCTGTGGCC	180
TTCGACAAGA AGGCAGCGAC GTTCAGACAC AAACTGCTCG TAAGCGACAA GGCGCAAAGG	240
CCAAAGACGC CGGCTCTCT AGTTCAAGCAG CTACCTTACA TCAAGCGGCT GATAGAAGCT	300
CTTGGTTTCA AAGTGCTGGA GCTGGAAGGG TACGAAGCAG ACGATATCAT CGCCACGCTT	360
GCAGCAAAGG GCTGCACGTT TTTTGATGAG ATTTTCATAA TAACCGGTGA CAAGGATATG	420
CTTCAACTTG TAAACGAGAA GATAAAGGTC TGGAGAATCG TCAAGGGGAT ATCGGATCTT	480
GAGCTTTACG ATTGAAAAAA GGTGAAAGAA AGATACGGTG TGGAAACCACA TCAGATACCG	540
GATCTTCTAG CACTGACGGG AGACGACATA GACAACATTC CCGGTGTAAC GGGATAGGT	600
GAAAAGACCG CTGTACAGCT TCTCGGCAAG TATAGAAATC TTGAATACAT TCTGGAGCAT	660
GCCCCGTGAAC TCCCCCAGAG AGTGAGAAAG GCTCTTTGA GAGACAGGGG AGTTGCCATC	720

CTCAGTAAAA AACTTGCAAC TCTGGTGACG AACGCACCTG TTGAAGTGGAA CTGGGAAGAG 780  
ATGAAATACA GAGGATACGA CAAGAGAAAA CTACTTCCGA TATTGAAAGA ACTGGAGTTT 840  
GCTTCCATCA TGAAGGAACT TCAACTGTAC GAAGAACGAG AACCCACCGG ATACGAAATC 900  
GTGAAGGATC ATAAGACCTT CGAAGATCTC ATCGAAAAGC TGAAGGAGGT TCCATCTTTT 960  
GCCCTGGACC TTGAAACGTC CTCCTGGAC CCGTTCAACT GTGAGATAGT CGGCATCTCC 1020  
GTGTCGTTCA AACCGAAAAC AGCTTATTAC ATTCCACTTC ATCACAGAAA CGCCCACAAAT 1080  
CTTGATGAAA CACTGGTGCT GTCGAAGTTG AAAGAGATCC TCGAAGACCC GTCTTCGAAG 1140  
ATTGTGGTC AGAACCTGAA GTACGACTAC AAGGTTCTTA TGGTAAAGGG TATATGCCA 1200  
GTTTATCCGC ATTTGACAC GATGATAGCT GCATATTGTC TGGAGCCAAA CGAGAAAAAA 1260  
TTCAATCTCG AAGATCTGTC TTTGAAATTCTCGGATACA AAATGACGTC 1310

(2) INFORMATION FOR SEQ ID NO:18:

- (i) SEQUENCE CHARACTERISTICS:  
(A) LENGTH: 436 amino acids  
(B) TYPE: amino acid  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:18:

Met Ala Arg Leu Phe Leu Phe Asp Gly Thr Ala Leu Ala Tyr Arg Ala  
1 5 10 15  
Tyr Tyr Ala Leu Asp Arg Ser Leu Ser Thr Ser Thr Gly Ile Pro Thr  
20 25 30  
Asn Ala Val Tyr Gly Val Ala Arg Met Leu Val Lys Phe Ile Lys Glu  
35 40 45  
His Ile Ile Pro Glu Lys Asp Tyr Ala Ala Val Ala Phe Asp Lys Lys  
50 55 60  
Ala Ala Thr Phe Arg His Lys Leu Leu Val Ser Asp Lys Ala Gln Arg  
65 70 75 80  
Pro Lys Thr Pro Ala Leu Leu Val Gln Gln Leu Pro Tyr Ile Lys Arg  
85 90 95  
Leu Ile Glu Ala Leu Gly Phe Lys Val Leu Glu Leu Glu Gly Tyr Glu  
100 105 110

Ala Asp Asp Ile Ile Ala Thr Leu Ala Ala Lys Gly Cys Thr Phe Phe  
115 120 125

Asp Glu Ile Phe Ile Ile Thr Gly Asp Lys Asp Met Leu Gln Leu Val  
130 135 140

Asn Glu Lys Ile Lys Val Trp Arg Ile Val Lys Gly Ile Ser Asp Leu  
145 150 155 160

Glu Leu Tyr Asp Ser Lys Lys Val Lys Glu Arg Tyr Gly Val Glu Pro  
165 170 175

His Gln Ile Pro Asp Leu Leu Ala Leu Thr Gly Asp Asp Ile Asp Asn  
180 185 190

Ile Pro Gly Val Thr Gly Ile Gly Glu Lys Thr Ala Val Gln Leu Leu  
195 200 205

Gly Lys Tyr Arg Asn Leu Glu Tyr Ile Leu Glu His Ala Arg Glu Leu  
210 215 220

Pro Gln Arg Val Arg Lys Ala Leu Leu Arg Asp Arg Glu Val Ala Ile  
225 230 235 240

Leu Ser Lys Lys Leu Ala Thr Leu Val Thr Asn Ala Pro Val Glu Val  
245 250 255

Asp Trp Glu Glu Met Lys Tyr Arg Gly Tyr Asp Lys Arg Lys Leu Leu  
260 265 270

Pro Ile Leu Lys Glu Leu Glu Phe Ala Ser Ile Met Lys Glu Leu Gln  
275 280 285

Leu Tyr Glu Glu Ala Glu Pro Thr Gly Tyr Glu Ile Val Lys Asp His  
290 295 300

Lys Thr Phe Glu Asp Leu Ile Glu Lys Leu Lys Glu Val Pro Ser Phe  
305 310 315 320

Ala Leu Asp Leu Glu Thr Ser Ser Leu Asp Pro Phe Asn Cys Glu Ile  
325 330 335

Val Gly Ile Ser Val Ser Phe Lys Pro Lys Thr Ala Tyr Tyr Ile Pro  
340 345 350

Leu His His Arg Asn Ala His Asn Leu Asp Glu Thr Leu Val Leu Ser  
355 360 365

Lys Leu Lys Glu Ile Leu Glu Asp Pro Ser Ser Lys Ile Val Gly Gln  
370 375 380

Asn Leu Lys Tyr Asp Tyr Lys Val Leu Met Val Lys Gly Ile Ser Pro  
385 390 395 400

Val Tyr Pro His Phe Asp Thr Met Ile Ala Ala Tyr Leu Leu Glu Pro  
405 410 415

Asn Glu Lys Lys Phe Asn Leu Glu Asp Leu Ser Leu Lys Phe Leu Gly  
420 425 430

Tyr Lys Met Thr  
435

(2) INFORMATION FOR SEQ ID NO:19:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 687 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: both
  - (D) TOPOLOGY: both
- (ii) MOLECULE TYPE: DNA (genomic)

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:19:

TCGTACCNNGG GNTCNCNANA TCGACTGCAG CATGCAAGCT GGCTAACATCAT GGTCATAGCT	60
GTTCCTGTG TGAAATTGTT ATCCGCTCAC AATTCCACAC AACATACGAG CCGGAAGCAT	120
AAAGTGTAAA GCCTGGGTG CCTAATGAGT GAGCTAACTC ACATTAATTG CGTTGCGCTC	180
ACTGCCGCT TTCCAGTCGG GAAACCTGTC GTGCCAGCTG CATTAATGAA TCGGCCAACG	240
CGCGGGGAGA GGCGGTTTGC GTATTGGCG CTCTTCGCT TCCTCGCTCA CTGACTCGCT	300
GCGCTCGGTC GTTCGGCTGC GGCGAGCGGT ATCAGCTCAC TCAAAGGCCG TAATACGGTT	360
ATCCACAGAA TCAGGGATA ACGCAGGAAA GAACATGTGA GCAAAAGGCC AGCAAAAGGC	420
CAGGAACCGT TAAAAAGGCC GCGTTGCTGG GCGTTTTCC ATAGGCTCCG CCCCCCTTGA	480
CGAGCATCAC AAAAATTCGA CGCTTCAAGT TCAGAGGTGG GCGAAACCCG ACAGGGACTA	540
TAAAGATTAC CAGGGCGTTT TCCCCCTGGG AAGCTNCCTT CGTGCCTCT CCTGTTCCCG	600
AACCTGGCCG GTTTAACCGG GATACCNGNT CGGCCTTTTN TCCCCTNNGG GGGAAANCCTT	660
GGGGNTTTTN GNAAAANGCT AAGGGTT	687

(2) INFORMATION FOR SEQ ID NO:20:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 701 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: both
- (D) TOPOLOGY: both

(ii) MOLECULE TYPE: DNA (genomic)

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:20:

GCTCGTACCG GGGATCTNNN ANATCGACTG CAGCATGCAA GCTTGGCGTA ATCATGGTCA	60
TAGCTGTTTC CTGTGTGAAA TTGTTATCCG CTCACAATTG CACACAAACAT ACGAGCCGGA	120
AGCATAAAAGT GTAAAGCCTG GGGTGCCTAA TGAGTGAGCT AACTCACATT AATTGCGTTG	180
CGCTCACTGC CCGCTTCCA GTCGGGAAAC CTGTCGTGCC AGCTGCATTA ATGAATCGGC	240
CAACCGCGGG GGAGAGGCAGG TTTGCGTATT GGGCGCTCTT CCGCTTCCTC GCTCACTGAC	300
TCGCTGCGCT CGGTCGTTCG GCTGCGCGA GCGGTATCAG CTCACTCAA GGCGGTAATA	360
CGGTTATCCA CAGAACATCAGG GGATAACGCA GGAAAGAACAA TGTGAGCAAA AGGCCAGCAA	420
AAGGCCAGGA ACCGTAAAAAA GGCCGCGTTG CTGGGCGTTT TTTCCATAGG CTCCGCCCC	480
CTGANGAGCA TCANAAAAAT CGANGCTCAN GTCANAGGTG GCGAAACCCG ACAGGNCTAT	540
TAAAAGATNC CCAGGC GTTT TCCCCCCTGG GAAGCTCCCT CGTGGGGCTC TCCTGGTTNC	600
GGNNCCCTGN CCGGNTTACC GGGGATAANC TTGTTCCGGN CTTTNTCCCC TTCNGGGAAA	660
ANGGTGGGGG GTTTTNTNNA AAAGGCTCAA AGGCTGGTAN G	701

(2) INFORMATION FOR SEQ ID NO:21:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 717 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: both
- (D) TOPOLOGY: both

(ii) MOLECULE TYPE: DNA (genomic)

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:21:

GNNTNTAGNNN GGNCTAANNG GCGGGGAAAT CGAGCTCGGT ACCCGGGGAT CCTCTAGAGT	60
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CGACCTGCAG	GCATGCAAGC	TTGGCGTAAT	CATGGTCATA	GCTGTTCCCT	GTGTGAAATT	120
GTTATCCGCT	CACAATTCCA	CACAACATAC	GAGCCGGAAG	CATAAAGTGT	AAAGCCTGGG	180
GTGCCTAATG	AGTGAGCTAA	CTCACATTAA	TTGCGTTGCG	CTCACTGCC	GCTTCCAGT	240
CGGGAAACCT	GTCGTGCCAG	CTGCATTAAT	GAATCGGCCA	ACGCGGGGG	AGAGGCGGTT	300
TGCGTATTGG	GCGCTCTTCC	GCTTCCTCGC	TCACTGACTC	GCTGCGCTCG	GTCGTTCGGC	360
TGCGCGAGC	GGTATCAGCT	CACTCAAAGG	CGGTAATACG	GTTATCCACA	GAAATCAGGG	420
GATAACGCAG	GGAAAGAACAA	TGTGAGCAAA	AGGCCAGCA	AAAGGCCAGG	AACCCGTAAA	480
AAGGCCGCGT	TGCCTGGCGT	TTTCCATAG	GCTCCGCCCC	CCTTGACGAG	CAATCACAAA	540
AATCGACGCT	CAAAGTCAAG	AGGTGGCGAA	ACCCCACAG	GGACTTATAA	AGATAACCCAG	600
GCCGTTTCCC	CCTGGAAGCT	CCCCTCCGTG	CGCTTCTCCT	TGGTTCCCGA	CCCTGCCGCT	660
TTACCNNGAT	NCCTGTCCGC	CCTTTNTCC	CTTTCNNGNA	ACCGGGCGCT	TTTTTTT	717

(2) INFORMATION FOR SEQ ID NO:22:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 713 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: both
  - (D) TOPOLOGY: both

(ii) MOLECULE TYPE: DNA (genomic)

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:22:

NNNNCNNNNG	GCTGANAGCG	ATAAATCGAG	CTCGGTACCC	GGGGATCCTC	TAGAGTCGAC	60
CTGCAGGCAT	GCAAGCTTGG	CGTAATCATG	GTCATAGCTG	TTTCCTGTGT	GAAATTGTTA	120
TCCGCTCACA	ATTCCACACA	ACATACGAGC	CGGAAGCATA	AAGTGTAAAG	CCTGGGGTGC	180
CTAATGAGTG	AGCTAACTCA	CATTAATTGC	GTTGCGCTCA	CTGCCCGCTT	TCCAGTCGGG	240
AAACCTGTCG	TGCCAGCTGC	ATTAATGAAT	CGGCCAACGC	GCGGGGAGAG	GCGGTTTGCG	300
TATTGGGCGG	TCTTCCGCTT	CCTCGCTCAC	TGACTCGCTG	CGCTCGGTG	TTCGGCTGCG	360
GCGAGCGGTA	TCAGCTCACT	CAAAGGCGGT	AATACGGTTA	TCCACAGAAT	CAGGGATAAA	420
CGCAGGAAAG	AACATGTTGA	GCAAAAGGCC	AGCAAAAGGC	CAGGAACC GT	AAAAAGGCCG	480

CGTTTGCTGG	CGTTTTCCC	ATAGGCTCCG	CCCCCCTTGA	CGAACCATCA	AAAAAATCGA	540	
CGCTCAATT	C	AGAAGTTGGC	GAAAACCCGA	CAGGACTAAT	AAAGATAACCC	AGCGTTCCC	600
CCCCTGGAAA	CT	CCCCCTCCG	TTGCGCCTCT	CCCTGTTCCC	GAACCTTGCC	CGCTTACCGG	660
GAATACCTTG	T	TCCNCCTTT	CTCCCCTTCC	GGGAANC GTT	NGCGCCTTTC	CCC	713